

Incorporating Climate Change in the North Atlantic Coast Comprehensive Study

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North Atlantic Coast Comprehensive Study

- The Congressional response to the devastation in the wake of Hurricane Sandy represents a need to address as a regional system the vulnerability of populations at risk in coastal regions in the U.S. Army Corps of Engineers (USACE) North Atlantic Division (VA to ME)
- Study goal: provide risk reduction strategies and promote resilient coastal communities, to reduce risk to vulnerable population, property, ecosystems, and infrastructure, considering future sea level rise and climate change scenarios.



North Atlantic Coast Comprehensive Study

- In 2013 USACE initiated activities including data compilation, problem identification, existing conditions characterization, and future-without project forecasting. In addition, federal, state, tribal, and non-governmental organization coordination was initiated.
- With full federal funding, the comprehensive study will be submitted to Congress in January 2015.
- <http://www.nad.usace.army.mil/Missions/CivilWorks/HurricaneSandyCoastalRecovery/NorthAtlanticComprehensiveStudy.aspx>



Climate Change Assessment for NACCS: Two-Phased Approach

Objective: provide consistent, up-to-date coastal forcing information for use in the NACCS and future project planning studies.

Phase I: Storm Tide and Sea Level Change Initial Assessment

- ▶ New analysis based on existing data
 - Use USACE/NOAA SLC scenarios
 - Statistical re-analysis of NOAA historical water level measurements
- ▶ Phase I data delivery by 1 August 2013

Phase II: U.S. Army Engineering Research and Development Center 'CSTORM' analysis

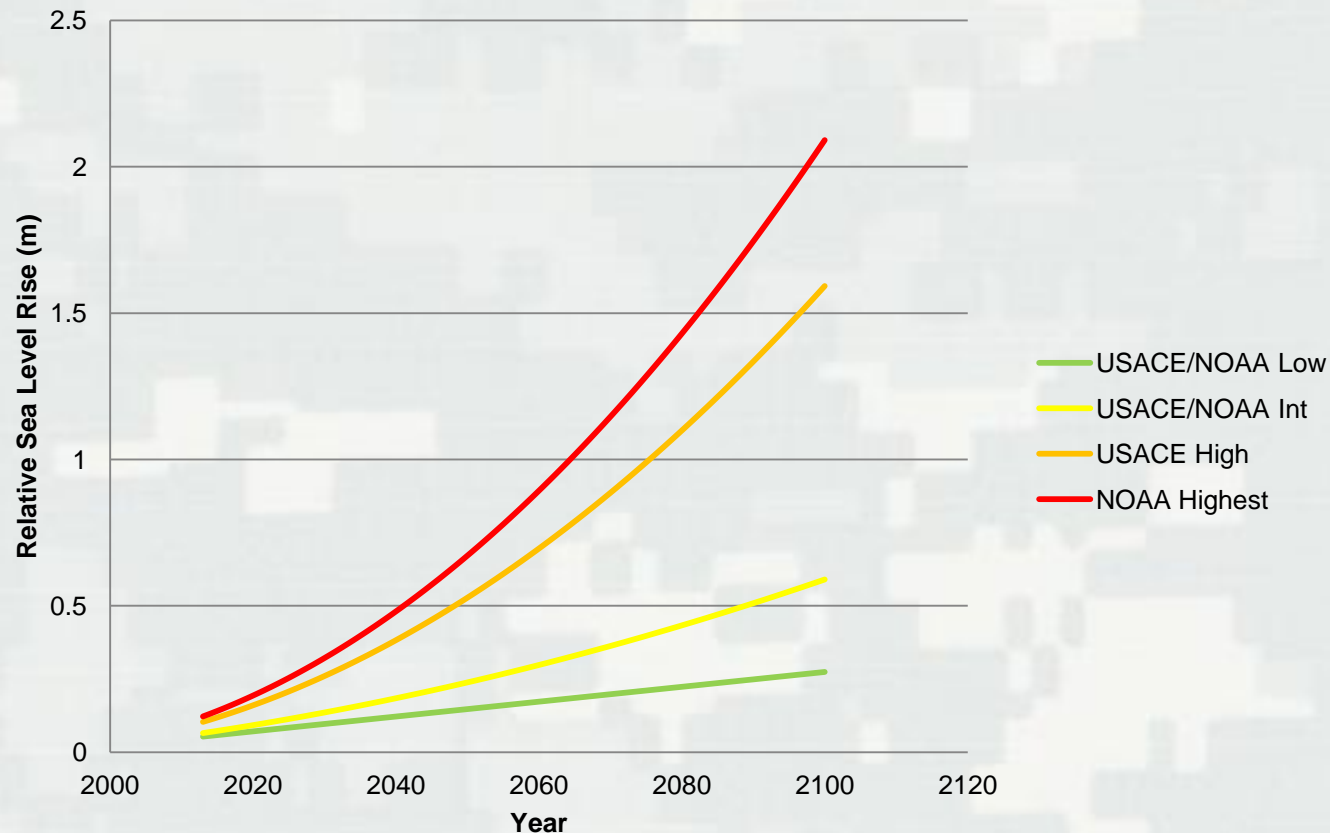
- ▶ Modern, risk-based storm climatology: Joint Probability Method (JPM)
 - Similar analysis performed for Gulf of Mexico following Hurricane Katrina
 - Future SLR incorporated into modeling
 - Evaluate storm climatology scenarios (frequency, track, intensity, etc)
 - Completely updated future storm risk with SLR
- ▶ Phase II delivery in Spring 2014



NACCS SLR Scenarios

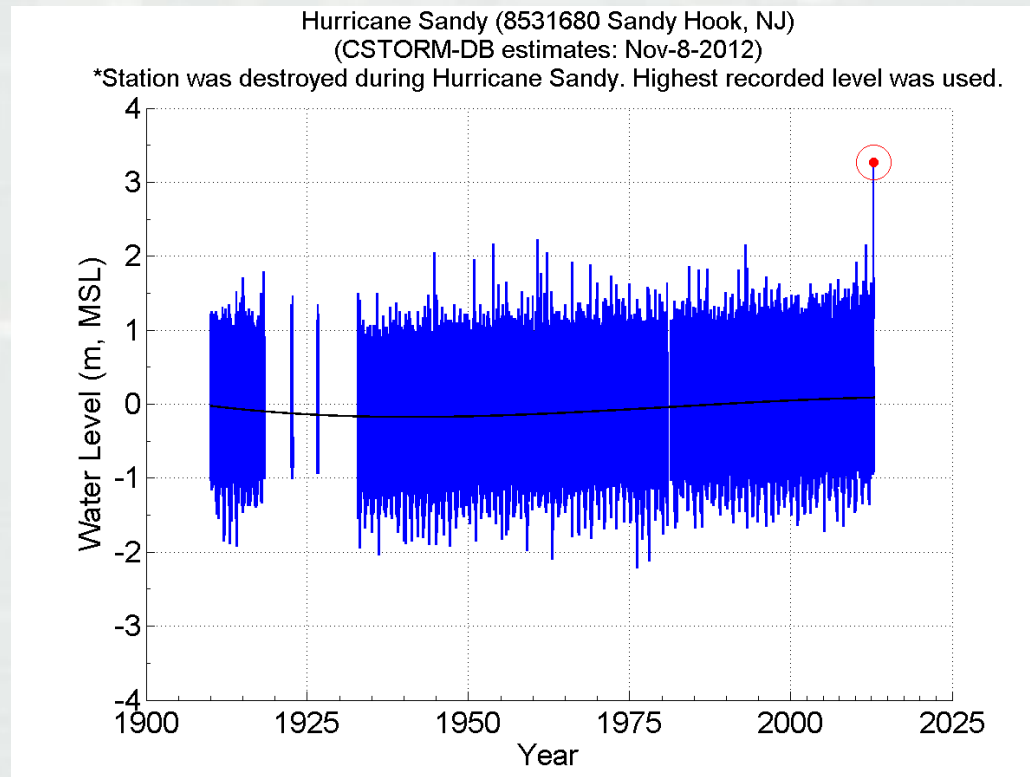
USACE 2011: Sea-Level Change Considerations for Civil Works Programs

NOAA 2012: Global Sea Level Rise Scenarios for the United States National Climate Assessment

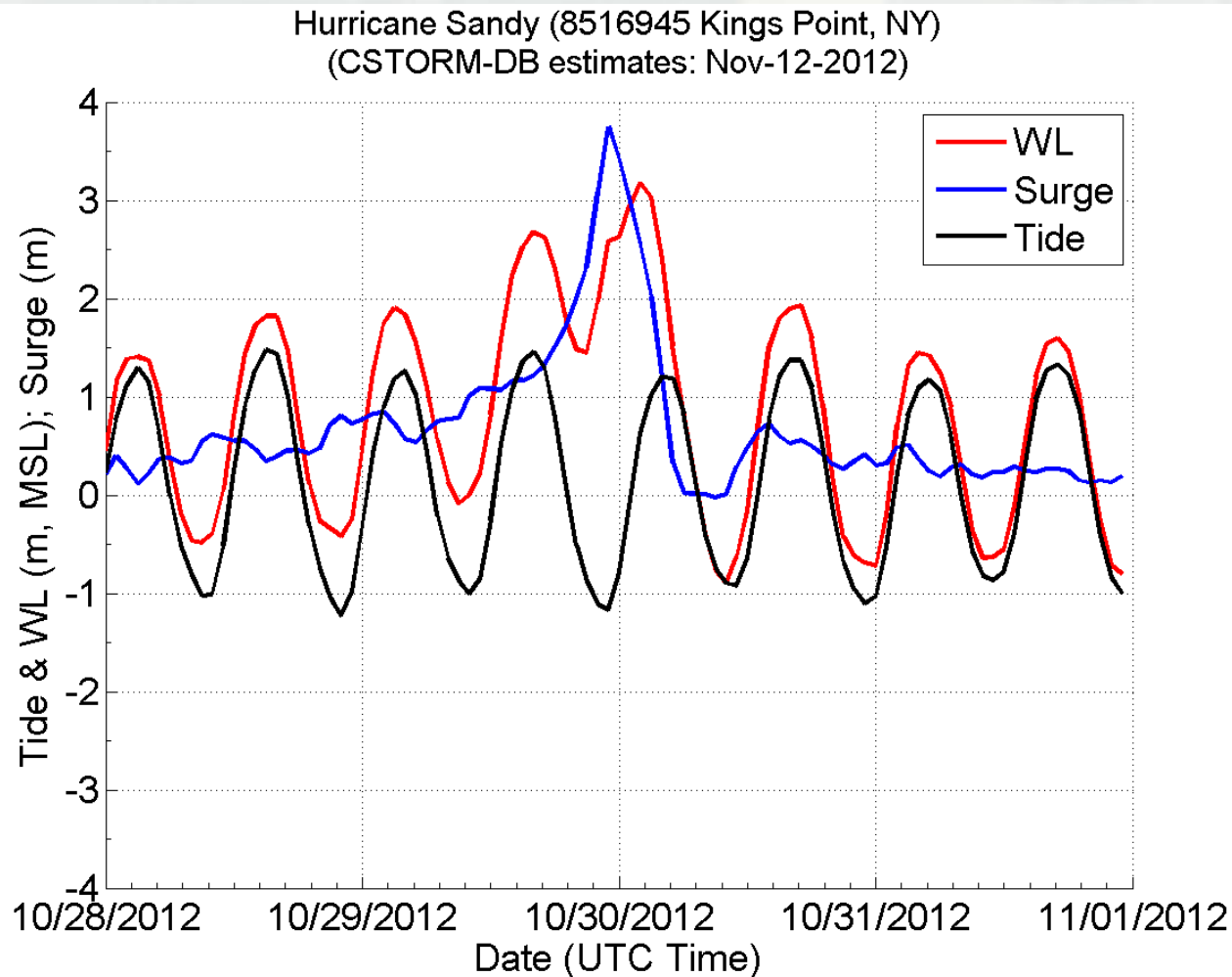


NOAA Water Level Gage Data

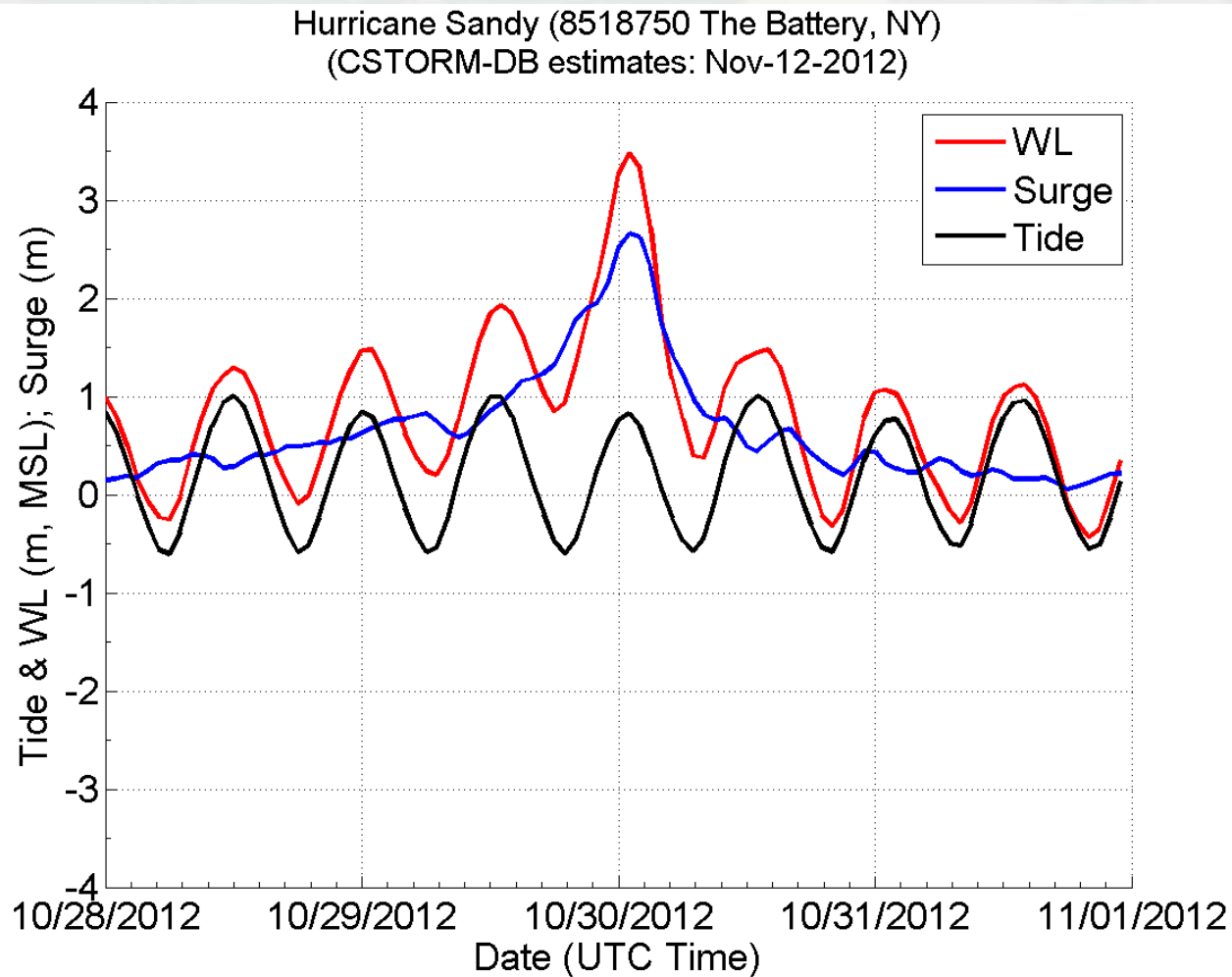
- 35 North Atlantic NOAA gage locations >30 year record
- 23 gages without data gaps/reliability issues



Storm Surge vs. Storm Tide



Storm Surge vs. Storm Tide



Storm Tide Return Period Procedure

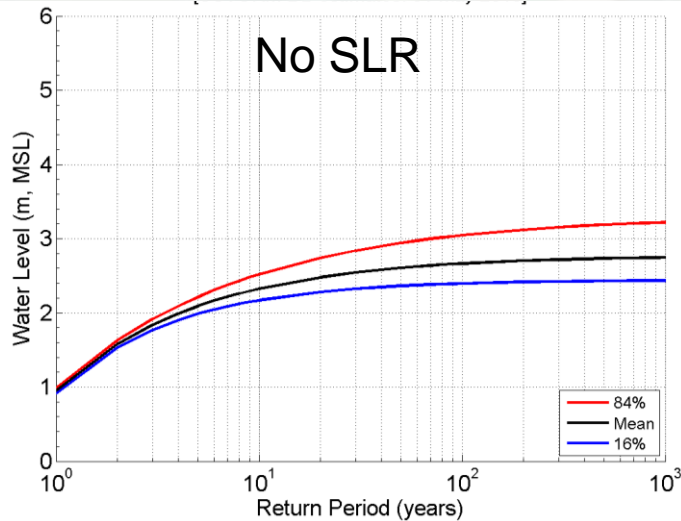
1. Twenty-three gages were selected from VA to ME based on record length and data integrity/quality.
2. Identify and document data gaps. Cross-check with NOAA-provided gap documentation and NOAA top 10 storm lists for data gaps. Document unverified periods, missing predicted or verified water level data.
3. Estimate residuals = verified WL – predicted WL. Residuals are termed surge in this report but it should be recognized that residual may include phenomena other than storm surge such as riverine flow.
4. Use peaks-over-threshold (POT) to sample storm events per year (λ), using only hourly data. Product is time histories of surge peaks.
5. Use 'Bootstrap'-like approach to extend each gage RL to match length of longest RL (e.g., 90 years), by sampling from the probability distributions. Product is 90-year surge hourly time history records.
6. Determine tidal amplitude/variability at each location and compute empirical cumulative probability distribution of tidal data for each gage.
7. Use Monte Carlo (MC) scheme to add tidal contribution to each storm WL peak. Perform sufficient MC simulations for each gage to assure a stable mean. Product is thousands of 90-year surge records for each gage that are statistically similar to the measured historical data.
8. Compute 4 sea level rise scenarios and add each to 90-year records to yield 4 total storm water level time series for each gage that represent water levels from 2010 to 2100.
9. Determine mean probability distribution curve (50% probability) and 90% confidence interval (C.I.) bands. Also compute overall maxima for the 4 life cycle scenarios. Compute range of return periods and tabulate.



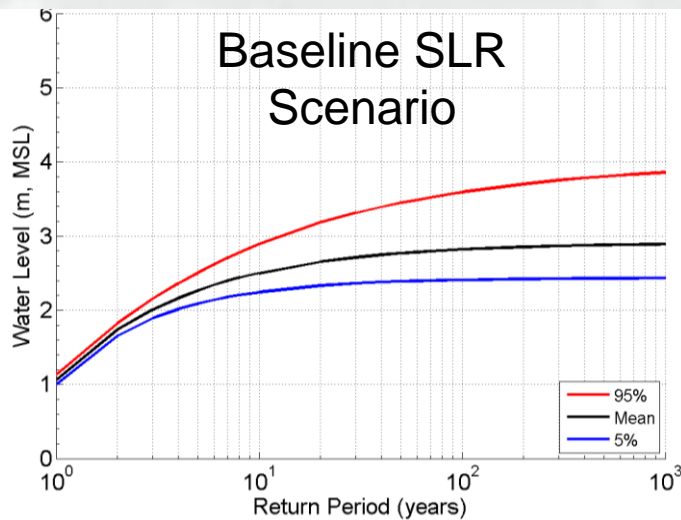
Phase I Climate Change Products

Storm Tide Return Periods

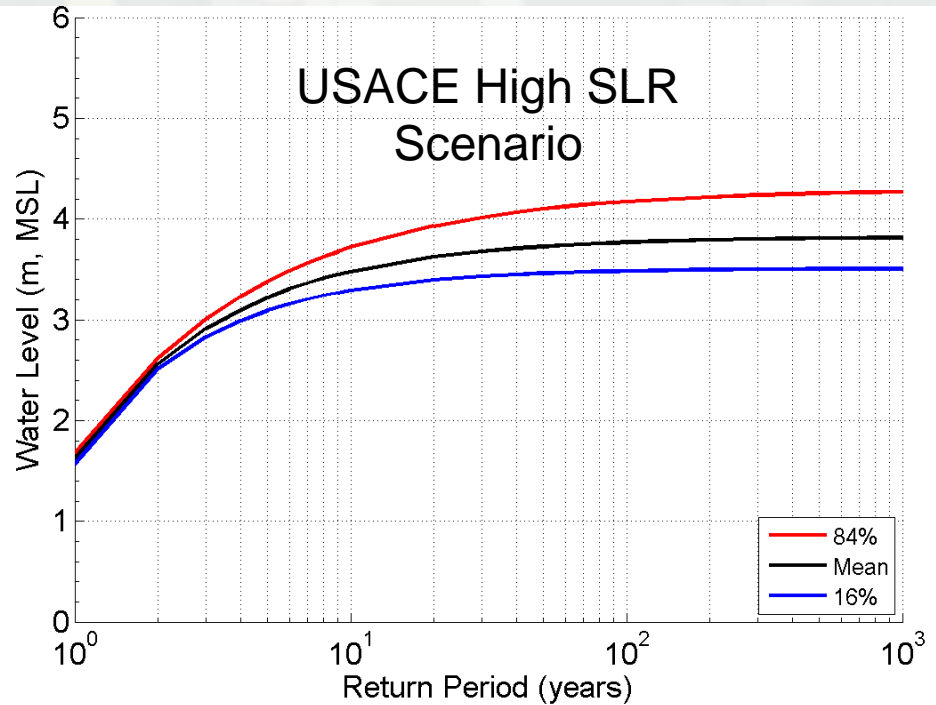
No SLR



Baseline SLR Scenario



USACE High SLR Scenario



Phase II: CSTORM Climate Change Scenario Evaluation

- Products: plausible storm suite that contains hydrographs of tropical storm waves and water levels throughout north Atlantic region (VA to ME)
- Scientists and Engineers from Engineering Research and Development Laboratory (technical), Institute for Water Resources (strategic/planning) and USACE Districts (Local/field knowledge) engaged in climate change scenario discussions
- Storm climatology scenarios will be integrated into CSTORM analyses. Specific scenarios TBD; future variations of storm track, forward speed, frequency, central pressure, radius to max. winds, etc
- Climate change results delivered with overall CSTORM deliverables in late 2014



Summary of Climate Change Considerations in the NACCS

Phase I, NOAA gage reanalysis data

- 4 SLR scenarios
 - Baseline (NOAA historical SLC rate)
 - USACE Intermediate
 - USACE High
 - NOAA Highest
- Water level return periods

Phase II, CSTORM plausible storm suite

- 4 SLR scenarios
- Storm climate change scenarios
- Storm water level and wave hydrographs

